Data Rights Valuation in Software Acquisitions

Stephany Head • Julianne Nelson
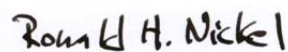
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Ronald H. Nickel

Ronald H. Nickel, Director
Cost, Acquisition, Readiness and
Logistics Team
Resource Analysis Division

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14. ABSTRACT
The right of the federal government to reuse, modify, reproduce, perform, display, release, and disclose data¾particularly computer software¾has become an important topic in contract negotiations. We describe the valuation methods used by DOD and industry to estimate software development costs and to assign value to data rights licenses that are broader than the default license described in DFARS. We find that the benefit to DOD arises from the impact of such licenses on future competition and costs. Two things must occur for expanded licenses to be worth the additional cost to DOD: the additional information covered by the license must be transferrable to alternative suppliers, either competing commercial companies or organic DOD facilities. Second, the information covered by the license must be useful to alternative suppliers, to the extent that it actually lowers their production costs.

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Contents

Executive summary

In response to the growing pressure to limit defense spending, acquisition professionals in the Department of Defense (DOD) are working to ensure that the government has access to the data needed to support competition, maintenance, and sustainment over the full life cycle of weapon systems. In DOD data acquisitions, the right of the federal government to reuse, modify, reproduce, perform, display, release, and disclose data—particularly computer software—has become an important topic in contract negotiations.

As part of the on-going DOD effort to update guidance on software acquisitions, CNA was asked to provide a synthesis of the literature on software valuation and to identify best practices for evaluating the prices quoted by suppliers for software licenses, including licenses for additional data rights. Negotiated on a contract-by-contract basis, such licenses provide the government with data rights to software above and beyond those that are generally conveyed with software deliverables (e.g., government purpose rights may be conveyed instead of only restricted rights to software).

This paper recognizes that the type of data that may be licensed by the government includes everything from technical data to software and special works. In most cases, the scope of rights that are generally conveyed with software deliverables depends on the nature of the funding used to create the software. Regardless, the contractor that created the data is always the owner and the copyright holder. Unless there are other restrictions, the contractor is also able to use the information for any other purpose.[1]

Given the complexity of discussing the full breadth of data rights, we focus in this paper primarily on computer software developed exclusively with private funds or with independent research and develop-

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[1] See DFARS 227.71 and 227.72 for policy statements on this issue. Examples of restrictions on use could in export controls or the terms specified in DOD Directive 5430.24.

ment (IR&D) funds. We assume that DOD is considering acquiring a license for government purpose rights (GPR) (i.e., the right to use, modify, reproduce, release, perform, display, or disclose within the government), instead of either restricted rights (RR) or the rights that are conveyed by licenses customarily provided to the public. The government's purpose in acquiring such expanded rights would be to address its life-cycle needs for the maintenance, sustainment, and competition as effectively and efficiently as possible.

In this paper, we describe the valuation methods used by DOD and industry to estimate software costs and to assign value to such expanded licenses. In general, industry focuses on initial development cost and on the importance for future profits of control over data rights. In contrast, DOD is concerned with life-cycle acquisition costs.

To determine DOD willingness-to-pay for expanded licenses, we characterize the solicitation process for software as a two-stage bargaining problem. Analyzing this stylized version of the acquisition process makes it possible to identify the factors that determine the value to the government of these licenses.

We find that the benefit of expanded licenses to DOD arises from their impact on future competition and costs. Two things must occur for expanded licenses to be worth the additional cost to DOD. First, the additional information covered by the license must be transferrable to alternative suppliers, either competing commercial companies or organic DOD facilities. Second, the information covered by the license must be useful to alternative suppliers, to the extent that it actually lowers their production costs. Unless both of these conditions are met, paying a higher licensing fee for an expanded license will raise, rather than lower, DOD acquisition costs.

We see that expanded licenses are valuable to DOD only to the extent that they allow alternative suppliers to bid more aggressively in the future. Furthermore, the extent of supplier cost savings attributable to expanded licenses defines the maximum that the government is willing to pay for the license itself. Paying more than this amount for a license would raise, not lower, life-cycle acquisition costs.

This approach provides a variety of practical insights for acquisitions professionals. It indicates

- what factors influence DOD's willingness to pay more for expanded licenses;

- how software cost models can be used to evaluate prices quoted for expanded licenses; and

- when companies are likely to refuse to quote a license fee for expanded licenses, or to quote a fee that exceeds the government's willingness-to-pay, or to abstain altogether from participating in the solicitation process.

We provide a variety of references that allow the reader to explore specific issues in greater depth.

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1 Introduction

In recent years, the debate over the ownership and control of data[2] and data rights has intensified as it has become increasingly essential to modern weapon systems.[3] Evidence of efforts to clarify the government's position on the acquisition of licenses for additional data rights can be found in recent legislation,[4] in Department of Defense

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[2] We use the term "data" generically to refer to any or all of the following: technical data, computer software, and special works. The formal definitions for these terms are discussed in appendix A of this paper.

[3] Nelson, Clark, and Spurlock observe that, "software plays an ever-increasing role in the operation of DOD weapon systems; Command, Control, Communications, Computers & Intelligence (C4I) systems; and management information systems" [1]. See also [2].

[4] Section 822 of the Duncan Hunter National Defense Authorization Act for FY 2009 [5] required the Secretary of Defense to issue guidance to

(1) establish criteria for defining the legitimate interests of the United States and the party concerned in technical data pertaining to an item or process to be developed under the agreement;

(2) require that specific rights in technical data be established during agreement negotiations and be based on negotiations between the United States and the potential party to the agreement...; and

(3) require the program manager for a major weapon system (or an item of personnel protective equipment that is to be developed using a non-FAR agreement) to assess the long-term technical data needs of such a system or item.

The Weapon Systems Acquisition Reform Act of 2009 [6] identified three measures involving data rights that were designed to encourage competition: (1) "use of modular, open architectures to enable competition for upgrades," (2) "acquisition of complete technical data packages," and (3) "licensing of additional suppliers."

(DOD) policy statements,[5] and in on-going initiatives to revise the Defense Federal Acquisition Regulations Supplement (DFARS).[6] This evidence indicates a growing awareness that decisions concerning license scope made during the initial stages of the acquisition process can have far-reaching implications over a program's life cycle [15].

In response to these policy initiatives, DOD acquisition professionals are reviewing sourcing and delivery practices as they confront the challenge of limiting sustainment costs. They view the strategic management of license scope as a fundamental opportunity for defense

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Section 824 of the Ike Skelton National Defense Authorization Act for FY 2011 [7] required the Secretary of Defense to review existing guidance concerning the acquisition of data rights "to ensure that the United States—

    (1) preserves the option of competition for contracts for the production and sustainment of systems or subsystems that are developed exclusively with federal funds as defined in accordance with the amendments made by this section; and

    (2) is not required to pay more than once for the same technical data."

This legislation also changes the status of technical data developed using IR&D funds received by a DOD contractor as an overhead charge on an existing contract. Such technical data are now to be treated as though they were developed using federal funds rather than private funds. This legislation was amended for consistency by Section 815 of the National Defense Authorization Act for FY 2012 [8].

[5] Recent memoranda from the Under Secretary of Defense ([9], [10], [11]) require DOD to adopt open systems architectures and to set rules for acquisition of technical data rights.

[6] Several DFARS cases in process at the beginning of 2012 directly addressed data rights issues. DFARS Case 2009-D031 [12] was a proposed rewrite of the rules authorizing access for certain types of government support contractors to technical data belonging to prime contractors and other third parties. DFARS Case 2010-D001 [13] was a proposed rewrite of all DFARS sections that pertain to technical data. (A version of this case has been in process since 2003; it was placed on hold in May of 2012.) DFARS Case 2012-D022 [14] was designed to provide guidance relating to rights in technical data under contracts for the production and sustainment of systems or subsystems.

and commercial entities to collaborate by increasing operational efficiencies, reducing development and sustainment costs, and creating market structures that encourage competition.

Nevertheless, licenses for additional data rights are potentially very expensive. Thus, determining the long-term implications of having access to this information is essential—particularly within complex contract structures where multiple layers of data rights are likely involved. To gain insight into this problem, policy-makers are seeking to address the following, basic questions:

- When should DOD require delivery of data?

- When should DOD obtain licenses for additional data rights?

- How much should DOD pay?

Data rights negotiations: context and outcomes

Why data and data rights are different from other goods and services

Data—defined as computer software and technical data for the purposes of this report—have been described as "intellectual property" [16], "intangible assets" [17], "public goods" [18], "knowledge" [19], and "proprietary information" [20]. These labels are used in various contexts to describe items that are expensive or difficult to create initially but that are free (or nearly so) to reproduce and distribute. Conventional goods, in contrast, are costly both to create and to reproduce and distribute.

Such labels clearly apply to the data that pertain to DOD acquisitions. For example, a ship hull design, the software code used in sensors, and the wiring diagram for an avionics circuit board are all costly to develop but, once developed, are virtually costless to reproduce and distribute.

The term "data rights" refers to the government's license rights in data. In other words, the government's data rights determine the extent of its ability to use, reproduce, modify, perform, display, release, and disclose data within the government and, under some circumstances, to disclose data outside the government to third parties.

Why data rights have value

In today's volatile technology market, companies that establish claims to intellectual property are often able to secure highly profitable contract terms. In such cases, proprietary technologies serve as barriers that make it more difficult for new companies to enter the market in question. For DOD, such barriers limit acquisition choices and increase the risk of vendor lock and monopoly pricing[7] [40]. Thus, current DOD policy emphasizes reducing entry barriers and encourages competition.

However, eliminating future barriers to entry may involve significant up-front cost. Under federal law, a firm that develops intellectual property (i.e., data) retains the title to it. Even if the intellectual property is developed with government funding, the government acquires a license for the data—not ownership. In general, the scope of this license will depend on the nature of the data, the source of funding, and the terms that were agreed upon during negotiations between the government and the supplier.

For industry, data—whether developed for the government or the commercial market—represent a potential source of future profits.[8] If a company owns intellectual property that is of interest to DOD—but is not already available either under license to the government or as a deliverable on a previous contract—it is likely that the company will agree to license the information only if it is compensated for the negative impact of the license on expected future profits.

As mentioned above, the value assigned to data (and to data rights) is defined through negotiations between DOD and its suppliers. Certain types of data rights are automatically conveyed to the government with unlimited rights. These include computer software

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[7] "Vendor lock" refers to a situation in which an organization becomes dependent on a single manufacturer or supplier for products or services. In other words, the organization cannot transfer work to another supplier without unacceptable costs or inconvenience. This dependence is typically the result of specifications or other technical data controlled by the incumbent (i.e., the current manufacture or supplier).

[8] In appendix B, we discuss the sources of market for non-commercial software developed for the government.

documentation delivered under contract; form, fit, and function data; and data that are necessary for installation, operation, maintenance, or training purposes (other than detailed manufacturing or process data).[9] For data rights that are not automatically conveyed, the starting point for such negotiations is determined by a combination of federal law, DOD regulations, and policy. Appendix A provides an overview of the default DFARS licenses for commercial and noncommercial software and technical data.[10]

As a general rule, default DFARS licenses for data depend on who paid for the initial cost of creating the work. The scope of default licenses increases as the government's share of the development cost increases. Nevertheless, it is important to remember that the default license merely defines the initial bargaining positions of the parties involved in DOD acquisitions. In the end, access to data is governed by the specific terms of the agreement that is negotiated by DOD and its suppliers.

Data rights debates

When suppliers have exclusive rights to data, DOD may be forced to award a series of sole source contracts. Some recent cases illustrate how limited access to data has prevented competing suppliers from responding to DOD solicitations.

- **M4/M4A1 carbine:** In the mid-1990s, the Army failed to safeguard a technical data package licensed from Colt Defense, LLC (Colt). As a result, the Army agreed in 1998 to amend the existing license and include a "sole source" provision naming

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[9] See DFARS 252.227-7013(b)(1) and 252.227-7014(b)(1) for a complete description of this category of data rights.

[10] We note in passing that although there are DFARS policy statements concerning the acquisition of licenses for commercial software, there is no default contract language. The presumption is that the government will acquire the license customarily granted to the general public—unless other arrangements are made or unless the terms of the customary license are not consistent with federal law. See DFARS 227.7202 for specific details.

Colt as the only authorized supplier of this weapon for a 10-year period.[11]

- **Apache helicopter, main rotor strap assembly**: In the late 1990s, McDonnell Douglas Helicopter Company (MDHC) independently developed an improved version of a rotor strap assembly that had been previously manufactured by KSD, Inc. Since the Army did not pay MDHC for these refinements, the court found that the Army had no claim to the technical data that defined the strap assembly. Without access to this information, KSD was not able to establish itself as an "approved source" and thus was unable to bid.[12]

- **SPITFIRE radio terminals:** To develop an organic repair capability for this equipment, the Army requested a technical data package from the manufacturer. The manufacturer subsequently quoted a price of $100 million for the data alone, an amount roughly equal to 80 percent of total program costs over a five-year period. As a result, the Army continued to purchase maintenance services from the manufacturer ([22], p. 17).

- **C-17 aircraft and F-22 aircraft**: The Air Force did not initially license the technical data needed to develop an organic maintenance capability at government repair depots. Some "subvendors" (subcontractors to the primary supplier) were later unwilling to provide the data rights that would allow the Air Force to establish this depot capability ([23], pp. 6–7).

- **C-130J aircraft:** The Air Force did not initially license the technical data needed to purchase C-130J spare parts through competitive procurements. When the prime contractor declined to provide a technical data rights package for these

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[11] After the sole source clause in the "M4 Addendum" expired in 2009, the Army issued an open solicitation and awarded a contract to a different supplier. The unit cost in the new contract was roughly half the price charged by Colt in its final delivery order. Appendix D presents the history of this dispute.

[12] Appendix E presents the facts of *KSD, Inc. versus the United States and McDonnell Douglas Helicopter Company* [21] as provided in the court's opinion. KSD protest of the sole source bid rationale was unsuccessful.

parts, the Air Force had to negotiate multiple partnership agreements with the sub-vendors who owned the proprietary data used in the production process ([23], pp. 7–8).

- **Up-armored High-Mobility Multipurpose Wheeled Vehicles:** The Army did not initially license the technical data needed to support a dual-sourcing response to a wartime surge in demand for this vehicle. The original manufacturer later refused to sell the technical data to DOD when demand grew from 1,407 vehicles in August 2003 to 8,105 vehicles in September 2004. As a result, the Army was unable to use alternative suppliers ([23], p. 8).

- **Airborne Warning and Control System (AWACS) spares:** The Defense Contract Management Agency recommended that the Air Force acquire AWACS cowlings (metal engine coverings) on a competitive basis because "the original equipment manufacturer's proposed price was not fair and reasonable and because another potential source for the part was available" [24]. However, the Air Force had not licensed the technical data needed to support such an acquisition strategy and thus was forced to award a sole source contract to the original manufacturer in 2003 ([24], pp. 10–11).

The next step

This paper provides advice on data rights questions in the context of software acquisitions. In the next chapter, we discuss the link between the choice of a software cost estimation methodology and the respective roles of DOD and industry as customer and supplier. We provide a brief introduction to many of the most popular estimation tools and indicate how they could be used by both DOD and industry analysts.

In chapter 3, we analyze software contracting as a bargaining problem in which DOD must choose whether to incur the cost of additional data rights—i.e., a "package" of rights above and beyond those which are automatically granted by the relevant DFARS clauses. We use a numerical example to illustrate the value to DOD of expanded license rights for software, and we provide a more general example in appendix C. We show how DOD's willingness to pay for such licenses is linked to their impact on future competition—and on the expected usefulness of the information to future suppliers (not on the

costs incurred by the original developer). This finding can be used by acquisitions officials to build a framework for evaluating bids that include prices for expanded licenses.

2 Valuation strategies for data rights

Over the past 20 years, software has become an important cost driver in DOD acquisitions, both large and small. Initial software development is labor intensive. However, many of the tasks associated with development occur only once.[13] Once software code has been written and tested, the initial developer need only replicate and distribute the code, which is usually an inexpensive process. Thus, permission to use, modify, reproduce, release, perform, display or disclose software code provides DOD (as customer) with an opportunity for substantial savings—as long as the supplier agrees.

In this section, we compare the methods that suppliers use to determine their "willingness to license" software with the tools that DOD uses to estimate its "willingness to pay." It is important to remember that even "noncommercial" software will generally have some market value. (We review the reasons for this claim in appendix B.)

The basic difference between the approaches used by DOD and industry is relatively straightforward: DOD expects to use software development cost models to assign a value to both software and expanded data rights (if any), while suppliers use market-based valuation techniques that are independent of initial development costs.

There are also differences in preferred negotiation processes. Some suppliers argue that the prices quoted for licenses for additional rights should not be finalized until near contract completion: at that point, the full value of the additional rights would be known. They also argue that negotiating these rights at the end of the contract could reduce risk for both DOD and the supplier and provide a fairer pricing calculation.[14]

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[13] Since the majority of software costs are based on human effort, many cost estimate methods provide costs in terms of human-months.

[14] Potter [53] argues that "the closer one comes to a final product, the more realistic will be the estimate of future cash flow. Waiting until near

In contrast, DOD acquisitions officials argue that they cannot defer data rights negotiations until the end of a contract: if they did, they would risk being held hostage by a supplier seeking excessive compensation. Despite these differences, all parties must agree on both the contracting process and the financial terms negotiated—or no contract will be awarded.

DOD approaches to data rights valuation

Currently, DOD has no standard method for determining the value of licenses for additional data rights. Each program office determines the details of its own approach; these approaches are typically based on some component of the overall software cost estimation exercise.

Below, we describe the types of tools that are used to estimate the overall development cost of software. In the next chapter, we discuss how these tools can be used to evaluate prices quoted for additional data rights–as distinct from the cost of the software itself.

Software size and software cost

Since writing software code is a labor intensive activity, most cost estimation models are based on a measure of software size.[15] There are several common measures; the simplest is source lines of code (SLOC).[16] Unfortunately, this intuitively appealing measure is diffi-

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the end of product development to negotiate royalties can, however, give rise to serious problems in reaching a negotiated settlement."

[15] Chapter 13 of the Air Force Guidelines for Successful Acquisition and Management of Software Intensive Systems [25] provides a general overview of the issue. The Software Development Cost Estimating Guidebook [26], developed by Price Systems LLC with the support of the Naval Center for Cost Analysis (NCCA) and the Defense Acquisition University (DAU), provides a detailed description of the mechanics of software cost estimating.

[16] David Wheeler—the author of SLOCCount, a popular open source tool used to estimate software development cost—defines SLOC as follows:

> A physical source line of code (SLOC) is a line ending in a newline or end-of-file marker, and which contains at least one non-whitespace non-comment character. Comment delimiters

cult to specify in the early stages of projects in general, for projects subject to "requirements creep," for projects dependent upon emerging technologies, etc. Two alternative measures of size are function points [29], [30], [31] and feature points [32]. The function point approach was developed to analyze management information systems (MIS); the feature point measure was developed for real-time or embedded systems. Predictive object points (POPs) [33], a newer measure, was designed to capture the distinctive architecture of object-oriented software. (Appendix F provides further details for these measures.)

The following models rely on SLOC, POPs, and other size measures to estimate software costs; they have been used singly or together by DOD to evaluate bids.

- COCOMO (COnstructive COst MOdel) was developed by Barry Boehm at TRW Aerospace and was first published in 1981 [34]. The original model was estimated using SLOC observations from 63 TRW projects. The current version, known as COCOMO™ II, allows the user to choose either SLOC or function points to develop software cost estimates. COCOMO™ II consists of a series of submodels that are used at different stages in the software development process.[17]

(characters other than newlines starting and ending a comment) are considered comment characters. Data lines only including whitespace (e.g., lines with only tabs and spaces in multiline strings) are not included. [27]

Leung and Zhang [28] review a number of alternative SLOC definitions.

[17] The *COCOMO™ II Model Definition Manual* [35] describes two of these submodels as follows:

- The Post-Architecture model is a detailed model that is used once the project is ready to develop and sustain a fielded system. The system should have a life-cycle architecture package, which provides detailed information on cost driver inputs and enables more accurate cost estimates.
- The Early Design model is a high-level model that is used to explore the architectural alternatives or incremental development strategies.

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- Software LIfecycle Management (SLIM) is a proprietary suite of cost estimating tools, which was created by Lawrence Putnam Sr. in 1978; it is currently distributed by QSM, Inc. SLIM can use either SLOC or function points (or both) to develop cost and schedule estimates for software projects.[18]

- PRICE-S is one of a family of models developed by PRICE Systems.[19] The current version of this model, TruePlanning, uses SLOC, function points, or POPs.

- The original SEER for Software (SEER-SEM) model was released in 1988 by Galorath, Inc. [38]. It is composed of a group of models working together to provide estimates of effort, duration, staffing, and defects; it supports both SLOC and function points [39].[20]

Most organizations have determined that using multiple data sources and multiple cost models can increase the accuracy of software cost estimates. Figure 1 provides an overview of a software costing exercise that uses two estimating tools.

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[18] Detailed information on the current version of SLIM is available at http://www.qsm.com/ [36].

[19] In 1973, the PRICE Hardware model (PRICE-H) was marketed by RCA PRICE Systems as the first widely available parametric cost-estimating tool. In 1976, RCA PRICE Systems released the PRICE Life Cycle (PRICE-L) model to address the maintenance or support costs of hardware once it had been developed or produced. The current version, TruePlanning, is distributed by PRICE Systems LLC. Documentation for this model is available at the following website: http://www.pricesystems.com/research/white_papers/True-S-White-Paper-no-NDA-Required.pdf [37].

[20] More detailed information on the current version of SEER-SEM is available at http://www.galorath.com/ [38].

Figure 1.   DOD software costing process
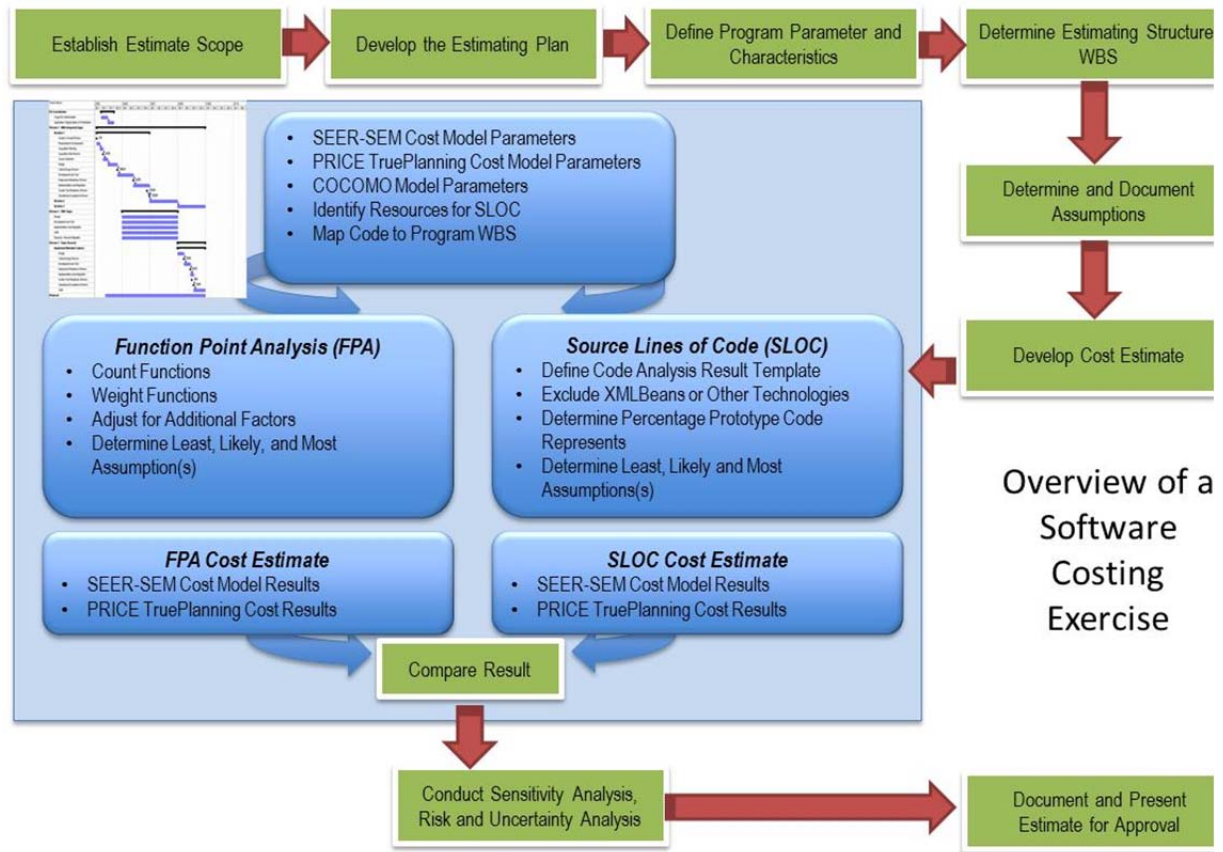
Industry approaches to data rights valuation

In practice, suppliers use licenses to protect proprietary innovations and to distinguish their products from those of their rivals [40]. In the absence of a license, there is little incentive for a technology firm to release proprietary information. In doing so, a supplier would risk diluting its competitive advantage and limiting its ability to earn profits—i.e., economic rents—in the future.[21]

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[21]   In a 2008 white paper, the executive director of Integrated Dual-use Commercial Companies (IDCC), Robert Spreng, defines economic rent as "what firms earn over and above the cost of the capital employed in their business. The objective of a firm is to increase its economic rent, rather than its profit as such. A firm, which increases its profits but not

According to Richard Razgaitis, a senior advisor at Charles River Associates,

> Virtually every technology-rich commercial business aggressively protects its proprietary data. This proprietary data defines the business and its potential. These commercial firms keep their proprietary data related to important commercial developments well protected within the organization. Normally only a relatively few trusted business and technical employees, with a vested interest in the commercial success of the development, will have access to the data until production scale up. [42]

For firms providing software to DOD, an acceptable price for additional data rights depends on the value of these rights in commercial applications and their impact on the market as a whole [44]. In this section, we review the range of tools typically used by suppliers to estimate the value of software licenses. This list provides DOD acquisitions professionals with background on how industry would prepare to come to the bargaining table.

1. The *market approach* considers a range of published values for similar data [44]. In this approach, value is estimated by (1) analyzing similar data that have been recently sold or licensed, (2) adjusting these observations for differences in the timing of previous transactions and in the nature of the product in question [45].

2. The *rating/ranking approach* is an extension of the market approach. The analyst reviews existing data licenses for similar technologies and ranks their observations on the basis of factors common to all licenses. Examples of such factors are the nature of protection, the scope of exclusivity, and the extent of improvement attributable to the licensed information [42].

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its economic rent—as through investments or acquisitions which yield less than the cost of capital—destroys value. Economic rent is the measure of the competitive advantage, which effective, established firms enjoy, and competitive advantage is the only means by which companies in contestable markets can earn economic rents" [41].

3. The *rule of thumb approach* (such as the 25-percent rule and other similar rules) apportions anticipated profits[22] from the commercial use of the data between the seller and buyer [46], [47].

4. The approach using *discounted cash-flow analysis with risk-adjusted hurdle rates*[23] focuses on the present value of the expected income to be earned from the subject data. When using this approach, it is important that the projected income stream be accessed accurately and that the projected stream be considered consistent and reliable [44].

5. The *advanced tools approach* is an extension of the discounted cash flow method. It applies statistical methods, such as Monte Carlo simulations, to discounted cash-flow models in order to test the impact of possible license terms on the expected outcomes of the agreement [49].

6. The *relief of royalty approach* calculates the present value of a stream of royalties that the technical data or computer software would have received using comparable historical data [50], [51].

7. The *cost approach* estimates the value of data by analyzing the cost to obtain an alternative capability [46], [47]. One method of estimating the cost is to compute the expected Remaining Useful Life (RUL) for the software in question. Practitioners note that a variety of factors affect both the overall value of the data and RUL. The following are examples of such factors:

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[22] Anticipated profit is the anticipated income flow discounted. Income can be influenced by a number of factors, including sales volume, per unit price, input costs, competition, overall economic climate, and government regulations. The discount represents the subjective risk of that income flow to its owner (investment value). The investment value discount rate is usually lower than the market value discount rate, resulting in a higher present investment value than present market value.

[23] The hurdle rate is the minimum rate of return on a project or investment required by a manager or investor. To compensate for risk, the hurdle rate increases with the risk of the project. It is usually calculated as the cost of the capital involved adjusted by a risk factor.

a. Expected use of the subject asset

b. Required maintenance expenditures to prolong economic life

c. Legal life and renewal provisions (if applicable)

d. Contractual issues, such as licensing and transfer price

e. Competing and emerging technology

f. Market demand

g. Other factors, such as industry volatility, unexpected changes in distribution channels or legislative actions

h. Professional judgment [52]

Most suppliers use the *advanced tools approach* in valuing software licenses. However, this method will not help DOD acquisitions professionals evaluate pricing proposals from would-be suppliers. The advanced tools approach assumes that it is possible to estimate a cash flow stream that is logically separate from the negotiations at hand. This is not the case when DOD negotiates with potential suppliers: it is these very negotiations that will determine the cash flow stream accruing to the data. Thus anticipated cash flow cannot be used as an independent evaluation criterion for price quotes.

As we see in the next chapter, the cost approach offers a means of avoiding this conundrum.

3 Negotiating for additional rights

As noted in the previous chapter, suppliers must consider how a transaction involving data will affect other business ventures—both current and future. The more important the intellectual property is to the firm's other business ventures, the more the firm will try to limit the release of this information, and the higher the value they will place on the data. In contrast, DFARS requires DOD to focus primarily on the nature of the data and source of funds used to develop them.

Figure 2 illustrates the combination of these perspectives—and identifies four general scenarios or cases. As we see below, only cases 3 and 4 are likely to lead to situations in which the would-be supplier is reluctant to negotiate—or is likely to quote a prohibitively high licensing fee.

Figure 2. Contractor's approach to data rights
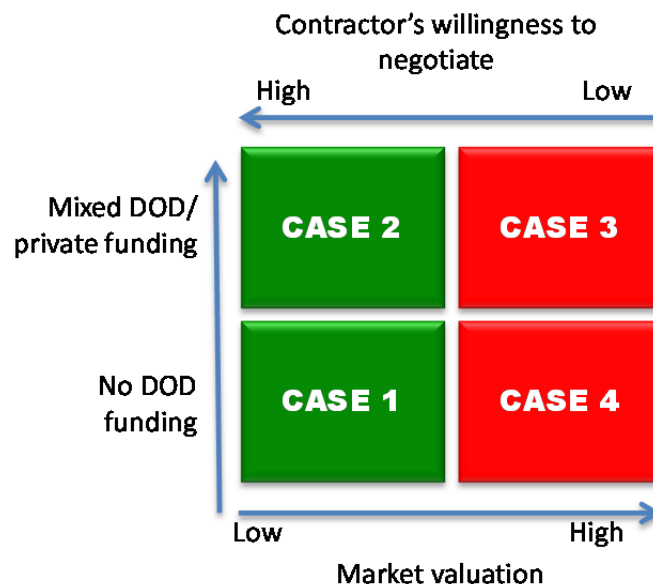
Case 1: Low market value, no DOD funding. This scenario is unlikely to pose problems. Because the data have few commercial uses, the supplier will likely be interested in negotiating. Since DOD has no direct investment in the development of the data, it should be reasonably easy to find common ground.

Case 2: Low market value, mixed DOD/private funding. Under DFARS, DOD obtains has government purpose rights to technical data and computer software that were developed with a combination of private and government funds. With no alternative customers, suppliers should be willing to negotiate a mutually agreeable licensing arranged for the data rights that do not automatically convey when innovations are substantially financed by the government. When there are few commercial customers for the product in question, the government is in a relatively strong bargaining position.

Case 3: High market value, mixed DOD/private funding. This combination is likely to cause conflict during negotiations. The contractor has a strong incentive to create market barriers and enhance the value of the firm by creating vendor lock. In contrast, DOD is likely to argue that it has rights to the data because it funded much of the development. For this scenario, the details of the deliverables specified in the contract are likely to have a significant impact on markets in the future.

Case 4: High market value, no DOD funding. When DOD is not directly paying for product development, suppliers rely on conventional intellectual property rights as the primary means to recoup nonrecurring costs and seek profit [43]. Examples of this scenario include "pre-existing" intellectual property that is essential to the firm's business and "commercial-off-the-shelf" (COTS)[24] products in general. Suppliers in this scenario generally have market power and are in a strong bargaining position.

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[24] COTS is a term used to define a non-developmental item (NDI) of supply that is both commercial and sold in substantial quantities in the commercial marketplace and that can be procured or used under government contract in the same precise form as available to the general public.

In the next section we examine the relationship between the market value of data and the benefit to the government of paying for additional license rights.

The benefit to DOD of data rights acquisition: an illustration

Below we present a numerical example to illustrate how data rights negotiations affect the contracting process. Specifically, we describe a two-period bargaining problem in which a DOD program office conducts a repeated acquisition. (A more general version of this bargaining "game" appears in appendix C.)

The acquisition involves multiple types of data and data rights, some of which will convey automatically to DOD. Access to the remaining data will require negotiations for appropriate licenses. (We refer to the full set of data rights involved in the acquisition as a "data package.") We assume that the bargaining environment is characterized as case 4 in figure 2 (i.e., a scenario in which suppliers have market power and are in a strong bargaining position).

To highlight the basic structure of the government's bargaining problem, we assume that DOD wants to acquire a product during each of two periods.[25] We also assume that contract execution requires both design and production effort during period 1, but only production effort in period 2, along with access to the data package created in period 1.

We suppose that the full data package is transferrable by license to one or more alternative suppliers in period 2—as long as such a provision is included in the terms of the period 1 contract. Access to the data package as government-furnished equipment (GFE) will lower period 2 production costs for any new supplier. However, treating the data package as a period 2 deliverable will increase period 1 production costs for the period 1 supplier.[26]

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[25] A similar scenario would apply to service contracts.

[26] For example, ensuring that technical data are transferrable may require additional documentation, record-keeping, and testing.

We rely on competition—however limited—to impose some form of price discipline. Specifically, for period 1, we assume that bidding will reflect competition among potential suppliers. For period 2, we assume that the successful period 1 bidder will not be able to charge more than the bid submitted by the next most capable alternative period 2 supplier.

Defining the potential value of technical data package to the government requires further assumptions about cost. We assume the following for period 1:

- The winning bid for period 1 development and production is $150 when no technical data package is requested.[27]

- The period 1 cost to the winning bidder of preparing a technical data package is $15.

For period 2, we assume the following:

- The production cost is $75 if the period 1 supplier (i.e., the incumbent) wins the period 2 contract.

- The production cost is $125 if a new supplier is chosen but does not receive a technical data package as GFE.

- The production cost is $90 if a new supplier is chosen and is provided with the technical data package developed in period 1.

In other words, we assume that access to a technical data package allows a new supplier to save $35 in period 2 production costs.

Figure 3 illustrates how the sequence of prices depends on the government's decision to request a technical data package as a deliverable.

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[27] This value is determined by competitive bidding among qualified suppliers in period 1.

Figure 3. Contract costs to the government
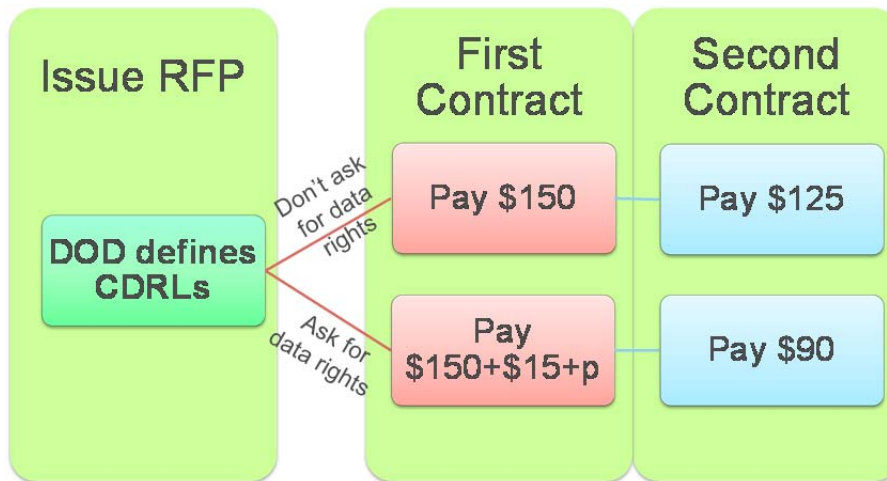
The next step is to compute the range of prices for the technical data package that would be acceptable to both the government and period 1 bidders. To solve this bargaining game, we start in period 2 and work backwards.

As mentioned above, we assume that competition with new suppliers determines the period 2 cost to the government for the product in question. In our example, no one would bid less than $125 in period 2 when no technical data package is available. To see why, consider the incentives for both potential period 2 suppliers and the incumbent supplier from period 1 in these circumstances.

- Potential new suppliers would lose money if they bid any less than $125 without access to a technical data package.

- The incumbent from period 1 has no incentive to underbid the period 2 competition.

Since more than one supplier would be willing to provide the product in question for at least $125, we assume that this is the outcome of the solicitation process in period 2.

In contrast, if a technical data package is available, then no one would bid less than $90. To see why, consider the bidding incentives in this alternative scenario.

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- Potential new suppliers would lose money if they bid any less than $90 when they have access to a technical data package.

- The incumbent from period 1 has no incentive to underbid the competition.

Thus we assume that $90 is the outcome of the period 2 solicitation process in this scenario.

Once we have defined the range of period 2 outcomes, we can move back in time to analyze the period 1 bidding problem that the government must solve in period 1. We start by computing the maximum amount of money that the government would be willing to pay to license the technical data package.

If a technical data package is not licensed, then the total cost to the government is the sum of the winning bids in each period:

$$Period\ 1\ bid + Period\ 2\ bid = \$150 + \$125 = \$275 \tag{1}$$

If a technical data package is licensed, then the total cost for the project (apart from licensing fees) is again the sum of the winning bids— including the added cost of package preparation:

$$Period\ 1\ bid + Period\ 2\ bid = \$150 + \$15 + \$90 = \$255 \tag{2}$$

Requesting a technical data package as a deliverable would reduce the government's total cost as long as the amount paid (p) for the license satisfied the following restriction:

$$255 + p \leq \$275 \tag{3}$$

Rearranging equation (4) yields a maximum value for p:

$$p \leq \$275 - \$255 = \$20 \tag{4}$$

In other words, the government's willingness to pay for a license is equal to the value of the license to a new supplier ($35 in this case) minus the cost of preparing the technical data package ($15 in this case). If the government paid any more than $20 for this license, the decision to request a technical data package would raise, rather than lower, the total cost of the project described here.

Data rights acquisition in practice

The numerical example above highlights the source of value to DOD of licensing data: in our model, life-cycle cost falls only if licensed data enables alternative suppliers to lower their production costs and to bid more aggressively in future solicitations. Thus, the value to DOD of an expanded license is determined by the extent of this cost saving.

The software cost models in chapter 2 can, in principle, provide an upper limit on the amount that DOD would be willing to pay for additional data rights licenses. We assume that such licenses would enable alternative suppliers to avoid the cost of developing the information in-house and that competition would force these suppliers to pass the savings on to DOD in the form of lower bids. In such circumstances, a software cost model could be used to estimate the expenditures avoided when an alternative supplier has access to software code. This amount is also the maximum savings that could be realized by DOD.

Our model indicates when potential suppliers may either choose not to bid or decide to refrain from quoting a price for additional data rights licenses. In the numerical example above, the period 1 supplier would receive at most $20 as a license fee. This may not be sufficient to offset the revenue that the firm expects to lose in its other lines of business—such as domestic commercial or international sales—once the license has been granted. In such cases, it is likely that the government's willingness-to-pay will be smaller than the supplier's willingness-to-sell. Thus no additional data rights licenses will be acquired.

The model provides a word of caution about the impact of technical data licenses on life-cycle costs. In the numerical example, if the government agreed to a license fee equal to its maximum willingness-to-pay, then the total acquisition cost would be the same whether a license fee was paid or not.

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4 Conclusions and recommendations

In DOD software acquisitions, the right to use, modify, reproduce, release, perform, display or disclose computer software (and computer software documentation) has become an important topic in contract negotiations. Federal law and regulations define the starting point for these negotiations. For software, this starting point includes a default assignment of data rights to both the government and the supplier(s) based on the source of funding. We observe that

- DOD typically obtains a license to use software developed under contract, not ownership of the code itself. (DOD does not own the code unless it was developed by a government employee.)

- For most types of data, the default terms of the license depend on the source(s) of funding used to pay for development costs of the item or component to which the data relates. The actual terms of the license are determined by negotiation.

- By default, DOD receives unlimited rights to certain categories of data, including

    o form, fit, and function data;

    o data that are necessary for operation, maintenance, installation, and training; and

    o computer software documentation required to be delivered under a government contract.

During negotiations, both government and industry need to distinguish between data rights and software as deliverables. From a DOD perspective, the value of software is determined by its capabilities; the value of data is determined by its anticipated impact on future competition.

DOD should not pay more today in license fees for expanded data rights than the benefit it expects to derive from using the rights in the future. This amount would generally be the present value of expected future cost savings. (If DOD paid more than the present value of future cost savings, it would have overcompensated industry: a $100 payment made today to compensate for a future loss of this amount will be worth more than $100 when the loss actually occurs.)

We found that the value to DOD of expanded data rights depends on the usefulness of the information to alternative suppliers and the implied impact on prices in the future. For example, access to a technical data package as GFE,

- may allow future competitors to avoid inventing alternatives to existing techniques; and

- may allow future competitors to use prior innovations without paying royalties or incurring test and evaluation costs.

Overall, DOD's maximum willingness to pay for expanded licenses is greater

- when the information is more useful to alternative suppliers;

- when the cost to the original developer of making data rights transferrable is lower; and

- when the impact on future prices is greatest.

Software cost estimating tools may be used to set an upper limit on DOD's willingness to pay for expanded license rights. DOD analysts will need to answer the following types of questions in the cost estimation process:

- What development activities do alternative suppliers avoid when given access to existing computer software and computer software documentation as GFE?

- To what extent will these cost savings be passed on to the government?

- What added preparation costs are incurred by the original developer to make the data rights transferrable?

Once such questions have been answered, conventional cost estimation tools can be used to estimate the cost savings.

We note that the separate acquisition of additional data rights will not always lead to future cost savings. To determine the likely benefit of broader licenses, DOD analysts need to address the following types of questions:[28]

- What data rights does the DFARS automatically provide to DOD?

- Will access to the additional rights requested actually allow for more effective competition in the future?

- What is the net effect on the DOD "top line" once the price of the expanded license and "transferability costs" are taken into account?

Our analysis indicates that acquiring data rights will provide less benefit to DOD

- when DFARS already provides DOD with substantial access to the data in question;

- when making the data rights transferrable requires additional costly documentation and testing to ensure compatibility;

- when the data covered by the data rights must be used in conjunction with a separate, proprietary technology;

- when there are few alternative suppliers capable of bringing "in-house" the technology covered by the data rights; and

- when sales to DOD represent a relatively small part of a supplier's customer base.

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[28] See the *OSA Contract Guidebook* ([43], p. 119) for a related list of questions to be used in a data rights assessment.

Recent guidance provides useful advice for acquisitions officials on when it is advisable to obtain a technical data license. We highlight four recommendations:

- Include an explicit request for data rights pricing in solicitations. (The *OSA Contract Guidebook* ([43], pp. 7, 56–58) provides examples of how to specify such requests.)

- Identify data rights as explicit deliverables. (The *OSA Contract Guidebook* ([43], appendix 11) provides examples of formal contract data requirements lists (CDRLs.)

- Include appropriate DFARS clauses in solicitation to establish contracting authority. (The table on page C-1 of the *OSA Contract Guidebook* [43] provides recommendations on which clauses to include in different types of solicitations. We reproduce this information as **Error! Reference source not found.** in appendix A.)

- Indicate how conformity with requirements will be validated. (The *OSA Contract Guidebook* ([43], pp. 28–29) recommends a Modular Open Systems Approach to validating conformance and provides sample solicitation clauses.)

Appendix A: Definitions and categories of data rights

Definitions

DFARS Sections 227 and 252.227 are the primary DOD sources of contract language used in acquisitions involving data rights. In this paper, we rely on the following definitions:

- "Technical data" is defined by Defense Federal Acquisition Supplement (DFARS) [54] § 252.227-7013(a)(14) as recorded information, regardless of the form or method of recording, of a scientific or technical nature (including computer software documentation), excluding computer software or data incidental to contract administration, such as financial or management information.

- "Computer software" is defined by DFARS [54] §§ 252.227-7013(a)(3) and 252.227-7014(a)(4) as computer programs, source code, source code listings, object code listings, design details, algorithms, processes, flow charts, formulae and relation material that would enable the software to be reproduced, recreated, or recompiled, but excludes computer databases or computer software documentation.

- "Commercial technical data" is defined by DFARS [54] § 252.227-7015(a) as recorded information, regardless of the form or method of the recording, of a scientific or technical nature (including computer software documentation). The term does not include computer software or data incidental to contract administration, such as financial or management information.

- "Commercial software" is defined by DFARS [54] § 252.227-7014(a). It refers to software developed or regularly used for non-governmental purposes which

    o has been sold, leased, or licensed to the public;

    o has been offered for sale, lease, or license to the public;

    o has not been offered, sold, leased, or licensed to the public but will be available for commercial sale, lease, or license in time to satisfy the delivery requirements of this contract; or

    o satisfies a criterion above and would require only minor modification to meet the requirements of a contract.

A matrix that shows when to incorporate specific DFARS clauses is provided in table 1, below.[29]

Table 1. Guidance on incorporating DFARS data rights clauses/provisions

When to incorporate DFARS clauses/provisions

DFARS clause 252.277-	7013	7014	7015	7016	7017	7019	7028	7030	7037
Mandatory for TD if noncommercial ICP is to be delivered	X			X	X		X	X	X
Mandatory if noncommercial CS is to be delivered		X		X	X	X	X		
Mandatory if TD for commercial items is to be delivered			X						X
Strongly recommended in all solicitations	X	X	X	X	X	X	X	X	X
Strongly recommended in all contracts	X	X	X	X		X		X	X

Technical Data = TD   Computer Software = CS   Item, Component, Process = ICP

Computer Software Documentation = CSD (TD)

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[29] This table is reproduced from p. C-1 of the *Contract Guidebook for Program Managers,* V.0.1, which was prepared by the DOD Open Systems Architecture Data Rights Team [43].

Categories of data rights

DOD may acquire four basic types of rights to noncommercial technical data:

- *Unlimited Rights*: With respect to noncommercial technical data and computer software, "unlimited rights" are defined as the right to "use, modify, reproduce, perform, display, release, or disclose" technical data, computer software and computer software documentation "in whole or in part, in any manner, and for any purpose whatsoever, and to have or authorize others to do so." (DFARS [54] §§ 252.227-7013(a)(16) and 252.227-7014(a)(15)).

- *Government Purpose Rights*: With respect to noncommercial technical data and computer software, "government purpose rights" are defined as the right to "use, modify, reproduce, release, perform, display, or disclose" within the government without restriction and the right to release or disclose outside the government for U.S. government purposes. (Here, "government purpose" refers to any activity in which the U.S. government is a party; this includes holding competitive procurements, but excludes modification, use, release, or disclosure for commercial purposes.) After five years (or some other period negotiated by the parties), the government's rights in such noncommercial technical data or computer software are automatically upgraded to Unlimited Rights (DFARS [54] §§ 252.227-7013(a)(13) and 252.227-7014(a)(12)).

- *Limited Rights*: With respect to noncommercial technical data, "'limited rights' means the right use, modify, reproduce, release, perform, display, or disclose technical data, in whole or in part, within the Government" and the right to release outside the government only if

  - the recipient requires such data to perform emergency repair and overhaul or if the release or disclosure will be to a "covered Government support contractor" or to a foreign government. (If the release or disclosure is to a foreign government, then the data released must

be other than detailed manufacturing or process data, must be in the interest of the U.S. government, and must be required for evaluation or informational purposes);

- o the recipient's contract contains DFARS [54] § 252.227-7025; and

- o the government notifies the owner of that technical data of such reproduction, release, disclosure, or use.

If technical data are provided to a recipient for purposes of emergency repair or overhaul, the recipient is required to destroy the technical data and all copies in its possession promptly following completion of the emergency repair/overhaul (DFARS [54] § 252.227-7013(a)(14)).

- *Specifically Negotiated License Rights*: Parties can modify the standard license rights granted to the government or obtain rights under circumstances where the government would ordinarily not be entitled to specific rights. Noncommercial technical data or computer software marked with "Specifically Negotiated License Rights" cannot be released outside the government unless

- o (1) the conditions specified in that license—which should be incorporated by reference into the contract and physically attached to the contract referenced in that restrictive marking—have been satisfied;

- o (2) the recipient's contract contains DFARS [54] § 252.227-7025; and

- o (3) the recipient has signed the Use and Non-Disclosure Agreement found at DFARS [54] § 227.7103-7(c) as modified by DFARS [54] § 252.227-7025(b)(3). (DFARS [54] §§ 252.227-7013(b)(4) and 252.227-7014(b)(4)).

In some cases, the government may accept less than Unlimited Rights or Government Purpose Rights in noncommercial technical data or computer software, but it cannot accept less than Limited Rights in noncommercial technical data or Re-

stricted Rights in noncommercial computer software. If, however, the technical data are of a certain type, the contractor may never restrict the government from releasing or disclosing such technical data outside the government, and the government is prohibited from negotiating away its Unlimited Rights to use, release, or disclose such technical data.

DFARS does not provide a clause defining the government's rights in commercial computer software (including Open Source Software (OSS)) [55]. Commercial software is generally acquired under the same type of license customarily provided to the public (provided that those licenses are consistent with federal procurement law and otherwise satisfy user needs). Such software is obtained competitively, to the maximum extent practicable, using firm-fixed-price contracts or firm-fixed-price orders under available pricing schedules [56].

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Appendix B: Market value for non-commercial software

There are two basic sources of market value for non-commercial software:

- Non-commercial software that was initially developed for government purposes may evolve into a "commercializable" product in the future. Examples of this situation include specialized semiconductor chips, programmable machine tools, and internet protocols.

- Non-commercial software is likely to include commercial components.

Either of these scenarios is sufficient to establish a link between a supplier's profit and the scope of the data rights provided to DOD for non-commercial software; we discuss each in turn below.

With respect to commercializing non-commercial software, we note that suppliers supporting federal programs are actively seeking opportunities to commercialize non-commercial code.[30, 31] The benefits

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[30] In a 1993 study, the Congressional Office of Technology Assessment found that

> there is enough commonality in military and commercial applications of some critical core technologies that defense spending over the years has strongly supported both. It has produced semiconductor chips of various kinds that find uses in autos and engineering work stations as well as guided missiles; programmable machine tools that can make parts for fighter aircraft or lawn mowers, tractors, and commercial airliners; computational techniques that model nuclear explosions or analyze what happens to cars in crashes. ([62], p. 4)

[31] In a 1994 study sponsored by DOD, Ferguson and DeRiso argued that

to the supplier in terms of revenue and market position are potentially quite large. The successful commercialization of code initially written for a government contract is likely to shorten the amount of time it takes to bring a new product to market, reduce development costs, and increase product quality (since the code has already been tested), thereby providing the supplier with a unique competitive advantage. In today's market—where firm valuation may depend directly on its portfolio of software products—the ability to transition non-commercial code to support or create a commercial product has become a raison d'être for suppliers. Thus, the valuation assigned to licenses for additional data rights has become more complex, as suppliers comprehend the future benefits of non-commercial code within the commercial market.

We next review the use of commercial components in non-commercial code in order to illustrate its importance for data rights negotiations. We note that software, both commercial and non-commercial, consists of modules or components. Many of these components implement features that are common to a wide variety of applications. Examples of such reusable components include

- sorting algorithms

- equation solving methods

- signal processing components

- data compression and format conversion algorithms

- security features (encryption, biometrics, etc.)

> Industry, with the move toward just-in-time ordering and agile manufacturing, is beginning to experience the need for large near real-time command and control systems similar to those long used by the DoD. Indeed, some industries, such as communications and manufacturing, have already developed systems similar to those used for tactical military command and control. These systems, depending on the application domain, consist of between 60% and 80% infrastructure (database, user interface, etc.). The market for this infrastructure will thus grow from one customer (the DoD) to many. ([63], p. 10)

- file indexing and search methods

- user interface conventions

- mapping and location tracking methods

- artificial intelligence modules; 3D simulation techniques

- queue processing and time-stamping functions

It takes time and talent to write efficient code for components of this sort. A potential DOD supplier that has privileged access to one or more of these components has an advantage when responding to both government and commercial solicitations. The following table lists potential sources of reusable software components and indicates the default license that would be delivered under the DFARS.

Table 2.   Software components and their associated rights

	Source of component	Associated rights
A	Code written using only funds from the DOD contract in question	May have use in future contracts; future value to prime contractor will depend on terms negotiated for the current contract. Government will receive unlimited rights in code identified as a deliverable.
B	Code written for a previous DOD contract that was required as a deliverable on that contract	This code would have been delivered with unlimited rights; however it may be hard to find, access, and reuse it.
C	Code written for a previous DOD contract that was not required as a deliverable	By default, government obtains restricted rights to this data if it is identified as a deliverable under the current contract; the government would have to negotiate for GPR rights or UL rights.
D	Code written by the prime contractor using private funds	By default, government obtains restricted rights to this code if it is identified as a deliverable under the current contract; the government would have to negotiate for GPR rights or UL rights.

Table 2. Software components and their associated rights

Source of component		Associated rights
E	Code written for the prime contractor by a subcontractor	Fee paid to subcontractor will depend on the nature of the deliverable required from the prime by the government. The default data rights license will depend on the "commercialness" of the subcontractor's contribution.
F	Code licensed by the prime contractor from a commercial source	By default, the government receives the standard license provided to the general public. The commercial vendor may be willing to provide a broader license in exchange for a higher fee.

In general, non-commercial software provided to the DOD will have components from more than one of these sources. Thus it will be important for DOD acquisition professionals to be aware of the factors that determine a contractor's willingness to negotiate.

Appendix C: Data rights licensing as a bargaining game

The act of requesting a price for data rights changes the structure of negotiations between DOD and technology firms that respond to a solicitation. To see why, consider the following situation. Suppose that DOD wishes to acquire a customized product in each of two periods and expects to issue a separate solicitation for each period. During the first period, the chosen supplier will design and manufacture the desired product. During the second period, either the period 1 producer (the incumbent) or a new firm will produce the next generation product.

The product design created in period 1 can be treated as data; DOD will acquire a license to this information as part of the contracting process. However, the specific terms of the government's license to the data will depend on a variety of factors, including

- the source(s) of funding used to develop design components;

- the extent to which the design is "commercial" (in the sense defined by the DFARS); and

- the details of negotiation prior to contract award.

To examine the sequence of events in this scenario, we define variables that represent values of interest to both industry and DOD. We adopt the following notation for periods 1 and 2:

Period 1

- $B_1^a \equiv$ winning bid when no data rights package is requested

- $d \equiv$ documentation and preparation cost (if any) needed to ensure "transferability" of data rights to one or more third party in period 2

- $p \equiv$ price of a license for the additional data rights that do not automatically convey to the government
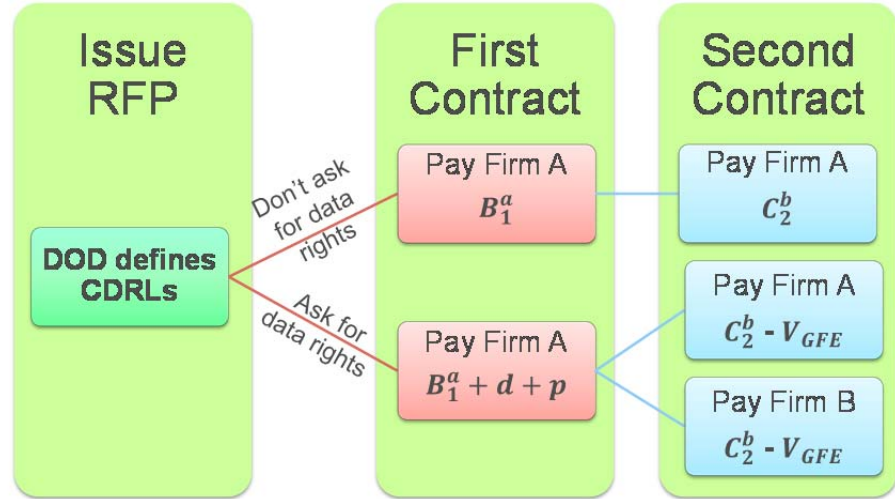
Period 2

- $C_2^a \equiv$ production cost for the incumbent firm

- $C_2^b \equiv$ production cost for any new supplier without access to the data developed in period 1

- $V_{GFE} \equiv$ the cost savings realized by a new supplier having access to all period 1 data as government-furnished equipment (GFE)

This notation makes it possible to characterize the sequence of events that define the life cycle of the product in question—and to do so in a general way. Several important assumptions should be considered:

- Access to data rights has the potential to lower period 2 production costs for non-incumbent firm(s) by the amount V_{GFE}.

- Treating data with data rights as a deliverable (requiring added documentation, testing, record-keeping, etc.) may increase costs for the period 1 supplier by an amount *d*.

- The competitive threat (however weak) posed by new suppliers defines the maximum amount that the incumbent firm can hope to receive in period 2.

Figure 4 below illustrates the decision tree implied by these assumptions. This decision tree illustrates the analytical framework needed to tackle the question, "What is the most that DOD would be willing to pay for the government purpose rights to the data developed for the first period contract?"

Figure 4.   The DOD decision tree

To answer the question, we start by identifying the foreseeable outcomes for period 2. We use this information to analyze the negotiating problem that DOD faces in period 1.

If DOD does not ask for data rights in the initial contract, then the incumbent firm will be in a strong bargaining position in period 2, and a vendor lock environment will be created. Without access to the incumbent's data, a competitor would have to develop an equivalent item, component, or computer software from scratch. Thus, the new supplier's total cost in period 2 would be significantly higher than the incumbent's production cost at that time. Since the incumbent knows this, we assume that the incumbent submits a bid equal to the minimum amount that would allow a competitor to break even (i.e., the incumbent bids C_2^b). We expect DOD to accept this bid since there is no one else who could do the job at a lower price.

The scenario is rather different when DOD acquires a license that allows it to transfer the design to one or more competitors. Such a license essentially becomes "government-furnished equipment" that would allow a new supplier to avoid having to develop an alternative design. Under the assumptions above, any new supplier given such a license would save V_{GFE} and would thus be able to compete more effectively with the incumbent. In this situation, we assume that competition among potential suppliers forces them to bid the minimum amount that would allow a new supplier to break even (i.e., they

would bid C_2^b - V_{GFE}). The incumbent anticipates this and matches the bids submitted by potential entrants.[32]

We next consider the period 1 bargaining problem. In the absence of a request for data rights pricing, we suppose that competition among period 1 bidders yields a price of B_1^a. If DOD requests data rights pricing, the winning bidder will face a cost increase of d (to cover the cost of data preparation) and will ask for an amount p in exchange for the data rights. Thus, the successful period 1 bid would be ($B_1^a + d + p$) when data rights pricing is requested.

In order for DOD to be willing to pay the amount requested for the data rights, the life-cycle cost of the product including data rights cannot exceed the life-cycle cost of the product alone. More formally,

$$(B_1^a + d + p) + (C_2^b - V_{GFE}) \leq B_1^a + C_2^b \qquad (5)$$

Simplifying equation (5) yields

$$p \leq V_{GFE} - d \qquad (6)$$

In other words, the price paid by DOD for additional data rights must be less than the net effect that this information has on the cost of using a new supplier in period 2.

The result suggests a method of developing a reality check for data rights valuations submitted by industry. In the above model, the maximum price that DOD is willing to pay is defined by new supplier's potential cost savings less any additional data preparation expenses sustained by the incumbent. A reasonable proxy for new supplier's cost savings would be an estimate of the resources required for such a firm to develop its own version of the data in question.

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[32] We tacitly assume that the incumbent is at least as efficient in production as a new entrant (i.e., that C_2^b - $V_{GFE} \geq C_2^a$). If the incumbent is less efficient than one or more of the potential entrants, then the final price would lie between C_2^a and C_2^b - V_{GFE}. The specific price would depend on the extent of competition among the potential entrants.

Appendix D: The M4 carbine controversy

In its review of the Army's decision to withdraw a 2006 M4 solicitation, the DOD Inspector General summarized the early history of the dispute between the Army and Colt Defense LLC as follows ([64], pp. 13–14):

> **(U) M4 Carbine Technical Data Package.** In June 1967, Colt and the Government entered into a patent license agreement for the M16 rifle. In March 1985, Colt and the Government extended the license agreement to include the M4 carbine because the M4 carbine was a derivative of the M16 rifle. The license agreement gave the Government limited rights to the technical data and placed restrictions on its use. The license agreement included a provision that limits the Army's right to transfer or release the technical data package.
>
> **(U) Inappropriate Release of the M4 Carbine Technical Data Package.** DoD Inspector General Report No. 97-165, "Procurement of the M4 Carbine," June 17, 1997, stated that, in January 1996, the Army released the M4A1 carbine technical data package to the Navy. The Navy requested the technical data package for internal use, but inappropriately released it in August 1996 to contractors in a solicitation for M4A1 adapter kits. Further, the report stated that the Army and Navy failed to protect the confidentiality of Colt's technical data package and had inadequate controls to safeguard Colt's proprietary data. The report concluded that the M4A1 technical data package was inappropriately released to contractors for purposes outside the scope of the M4 license agreement.
>
> **(U) Lawsuit Regarding the Inappropriate Release of the M4 Carbine Technical Data Package.** Colt filed a lawsuit against the Government regarding the rights and responsibilities of each party under License Agreement DAAF03-67-C-0108. On December 24, 1997, as a result of the legal settlement, the Government and Colt entered into an addendum to the Technical Data Sales and Patent License for the M4 carbine which clarified the safeguards to be undertaken by the Government with respect to control and dissemination of licensed technology. M4 carbine licensed technology

> includes proprietary data, improvements, and intellectual property. Proprietary data includes the technical data package.

In other words, Colt agreed to drop its damage claim against the Army and, in exchange, was granted sole source status for a decade. When in 1999 a potential supplier challenged the legality of this agreement,[33] the Court of Federal Claims found that,

> this agreement recognizes and establishes Colt's claim to proprietary data rights in the M4 carbine and its components.... Because of this acknowledgment of Colt's proprietary data rights in the M4, the Government has disabled itself from procuring that weapon on a competitive basis. Of necessity, Government procurement of the M4 may now proceed only through purchases from Colt's. [65]

The sole source clause in the M4 Addendum lasted for 10 years; it expired in July 2009. As table 3 shows, the unit price for an M4 rose significantly from 1999 through 2006. In 2006, the Army issued a presolicitation notice indicating its intent to award a contract for an alternative to the M4. Colt responded by lowering its price and offering to provide attachments that had been previously provided by the government.

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[33] FN Manufacturing, Inc. v. the United States and Colt's Manufacturing Company, Inc., 44 Fed. Cl. 449 [65].

Table 3.   M4 unit price history

Date	Unit price[a]	Item purchased	Contract/ Delivery order
Dec-99	$521	M4 carbine	DAA20-98-C-0082-P00011
Dec-02	$912	M4 carbine	DAA20-02-C-0115-P00004
2005-2006	$1,012	M4 carbine	W52H09-04-D-0086-0040
Feb-06	--	Presolicitation notice for M4 replacement	W52H09-06-R-0195 (cancelled 6/2006)
3/2006: Colt Price concession	$815 / $1,142	M4-carbine/ M4-carbine with BUIS and ARS[b]	W52H09-04-D-0086-0040
Dec-10	$1,221	"fully-equipped carbine"	W52H09-07-D-0425-BR02-
Apr-12	$673 [c]	R4 (Remington)	W56HZV-12-D-0056[c]

a. Unless otherwise indicated, price data are taken from [66].

b. BUIS refers to "Back Up Iron Sight"; ARS refers to "Adaptor Rail System."

c. Price and contract information are taken from [67].

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Appendix E: KSD, Inc. v. U.S. and McDonnell Douglas Helicopter Company (MDHC)

This case illustrates the importance of considering the long-term effects of not securing data rights for key products that require multiple purchases or long-term contracts. The opinion issued by the United States Court of Federal Claims describes the facts of the case as follows:

> This case arises out of a solicitation for main rotor strap assemblies for the AH-64 Apache Helicopter. The main rotor strap assembly retains the main rotor blade to the rotor hub of the helicopter. In 2001, the Army awarded a sole source contract to MDHC for an "improved" main rotor strap assembly, which is commonly referred to by contractors and the government as a "Fat Boy" strap pack. Before the Army began acquiring the "Fat Boy" strap packs from MDHC, the plaintiff, KSD, had provided the Army with an earlier version of the strap pack, known as the "Jenny Craig" strap pack. The 2001 sole source contract to MDHC for "Fat Boy" strap packs expired on December 31, 2005. A new solicitation was issued, a contract awarded, and KSD protests the sole source award of the 2005 "Fat Boy" contract to MDHC.
>
> On May 17, 2005, the United States Army Aviation and Missile Command (AMCOM) published a pre-solicitation notice for solicitation No. W58RGZ-04-R-0982 on the Federal Business Opportunities (FedBizOpps) website, **Error! Hyperlink reference not valid.**. The May 17, 2005 notice announced a requirement for 135 parts in support of the Army's AH-64 Apache Helicopter. One of the parts listed in the notice was the Main Rotor Strap Assembly, part no. 7-511411146-3, which is the "Fat Boy" strap pack assembly. The Army had designated the "Fat Boy" strap pack assembly a critical safety item "whose failure, malfunction, or absence could cause loss of or serious damage to the aircraft and/or serious injury or death to the occupants." For this reason, the part could be procured only from an "approved source" that has satisfied the Army's engineering and testing requirements. The May 17, 2005 notice stated that the Army intended to award McDonnell Douglas Helicopter Company (MDHC) a three-year, indefinite delivery, indefinite

quantity (IDIQ) contract for the 135 different parts, including the "Fat Boy" strap pack assembly, on a sole source basis. KSD, Inc. (KSD) protested the 2005 sole source award of the "Fat Boy" contract to MDHC.

In 1996, before KSD had submitted its unsolicited proposal to modify the "Jenny Craig" strap pack, Boeing had submitted its own unsolicited proposal to design an improved strap pack for the United States Army Aviation and Missile Command (AMCOM). AMCOM conducted an economic evaluation of Boeing's proposal and verbally advised Boeing that government funding was not available for the design of the new strap pack. Boeing, however, was advised that it could pursue an improved strap pack under the Department of Defense's "commercialization initiative," pursuant to which "industry designs, develops and qualifies a new product at their own expense, and then markets it to their customers." In September, 1999, while Boeing's qualification procedure of the "Fat Boy" was underway, KSD requested an opportunity to compete as a prime vendor for the "Fat Boy" strap pack and requested all engineering data required to support the redesign and testing of the current strap pack assembly. AMCOM responded to KSD's request on October 5, 1999, informing KSD that because the government did not pay Boeing for the redesign of the strap packs, the data is considered proprietary to Boeing and, therefore, cannot be provided for KSD's use. In the same letter, the Army offered to assist KSD in redesigning and qualifying a new strap pack. Specifically, the Army stated that "if KSD is interested in redesigning and qualifying a strap pack, the Government will afford the same assistance given to Boeing during its redesign and qualification. There is no evidence in the record that KSD responded to this offer for assistance.

On July 18, 1999, the government issued a Justification and Approval (J&A) for a sole source contract of the improved "Fat Boy" strap packs to MDHC. In the J&A, the Army stated that "MDHC is the only responsible source capable of providing the supplies or services necessary for manufacture of Apache Longbow aircraft." In a letter sent to AMCOM on September 10, 1999, KSD expressed its concern over the sole-source contract to Boeing, informing AMCOM of KSD's history with the manufacture and production of helicopter strap packs, including more than 4,000 strap packs that were ordered by the Army from KSD for the AH-64 helicopter. In the letter, KSD also requested that it be provided the same opportunity to compete on the 1999 contract as the prime vendor. In response to KSD's September 10, 1999 letter, and

to KSD's concerns about the sole source contract to MDHC, the Army stated that Boeing had performed all of the research and development on the new strap pack with no government funding. Therefore, AMCOM contended: "Since the Government did not pay for the Boeing redesign of the strap pack, the data is considered proprietary to the Boeing Company and therefore cannot be provided for KSD's use."

On August 1, 2000, the Army approved Boeing's qualification for its design of the "Fat Boy" strap pack. On November 29, 2000, AMCOM Contracting Officer Robert Deppe 2 executed another J&A for other than full and open competition with respect to the procurement of "Fat Boy" strap packs. The November, 2000 J&A concluded that: "The Apache Attack Helicopter Project Manager's Office has found no other contractor that possesses the detailed technical information required to manufacture the strap packs. No viable competitive alternative exists for this requirement as MDHC is the only source possessing the required technical data and corporate knowledge." The following day, AMCOM published a pre-solicitation notice in the Commerce Business Daily (CBD) providing notice of the procurement of 2100 "Fat Boy" strap pack assemblies upon a sole source basis, with an option to purchase additional strap packs as spares. The notice also stated that a sole source award was justified because "the strap pack is a commercial product developed by MDHC and the technical data is proprietary to the manufacturer." KSD filed an agency level protest on December 7, 2000, asserting that the "Fat Boy" strap pack was not a commercial item or product as justified by the Army in its November, 2000 J&A. By letter dated February 14, 2001, the Army denied KSD's protest. The Army stated in its denial of KSD's agency protest that: "The use of the term 'commercial' as stated in the [Commerce Business Daily] synopsis has been misconstrued and is not used in context of the definition for a commercial item in FAR Part 2.0." The letter continued that the "Fat Boy" had been "solely developed by MDHC under a contractor funded commercialization program."

On March 19, 2001, the AMCOM Small Business Administration (SBA) Competition Advocate, Wade Griffin, Jr., approved the November, 2000 J&A, but recommended acquisition of "the basic quantity only" (emphasis in original). In addition, Mr. Griffin requested information concerning "potential sources seeking qualification prior to any option exercise." On April 3, 2001, three weeks later, Ralph Massey,

an SBA Procurement Center Representative, sent a memorandum to Mr. Griffin which stated that the "Fat Boy" contract would result in the Army "for all practical purposes, be using this sole source buy to repay Boeing/McDonnell [somewhere between $15M and $20M] for their Non-Recurring Engineering costs for both the development and qualification testing of the new strap assembly." A subsequent memorandum from Mr. Massey in the record, dated April 27, 2001, stated that, "This procurement is a perfect example of the fallacy of depending upon the 'DOD Commercialization Initiative' program to fund needed redesigns of items on a weapons platform, rather than having a PM include an adequate funding line in the POM." The same memorandum indicated that the initial procurement may have been caused by the Army's failure to plan funding for the redesign of the strap pack. Specifically, Mr. Massey stated: "The current undesirable sole source acquisition situation can be traced directly to the decision in the mid-1990s by the 'Strap Team' at St. Louis which did not adequately push the case for NRE [Non-Recurring Engineering] funds to support competition on re-design of an improved MR strap assembly."

On July 31, 2001, the Army awarded MDHC a sole-source contract, No. DAAH23-01-C-0092, to supply 1,992 "Fat Boy" strap packs to AMCOM, with a government option to purchase an additional 220 strap packs. Also, on the same date, the Army modified a different existing contract, No. DAAH23-00-C-0001, for MDHC to provide 240 "Fat Boy" strap packs. Under each contract, the unit price of the "Fat Boy" strap pack was [deleted].

In the 2001 contract and in a separate modification of an existing contract, the government and MDHC specifically agreed that the technical data rights pertaining to the "Fat Boy" strap pack would not be provided to the government. Specifically, the 2001 contract incorporated the clause at Defense Federal Acquisition Regulations Supplement (DFARS) 252.227-7015 (NOV 1995), "Technical Data - Commercial Item," and stated that the section "[a]pplies to Improved Strap Pack, P/N 7-511411146-1. Technical Data pertaining to Improved Strap Pack is not delivered under this contract. The Government's rights are limited to the rights defined in this clause." Similarly, the contract modification for contract No. DAAH23-00-C-0001 stated: "Both parties agree that DFARS [2]52[.]227-7015 is incorporated by reference in Section I and applies to the design and development technical data of the Improved Strap Pack, P/N

7-511411146-1 only. The only data to be delivered under this effort is specified in Section C, Statement of Work, Attachment 01."

On May 17, 2005, AMCOM posted its pre-solicitation notice on the FedBizOpps website advertising that it was going to sole-source the "Fat Boy" strap pack contract to MDHC. The notice stated that AMCOM intended "to establish a three (3) year Indefinite Delivery Indefinite Quantity (IDIQ) type contract with two unpriced options to extend the period of performance for an additional three years (each option) applicable to AH-64 Apache Helicopter Spares." KSD submitted an agency level protest to AMCOM on August 15, 2005. KSD based its agency protest on two claims. First, KSD argued that the "Fat Boy" strap pack was a modification of an existing part, which was owned by the government, and that the modification was based on a "Commercialization Initiative," but that the new part does not meet the definition of a "Commercial Item" under FAR 2.101 (2005). Second, KSD argued that the solicitation for the "Fat Boy" strap pack did not "conform with the spirit, intent, or requirements of the Competition in Contracting Act of 1984." KSD stated that the Army's action "has resulted in all competition being eliminated for this item in the future." Among the relief requested, KSD asked in its agency protest that the Army provide KSD with technical data so that it could submit a Source Approval Package.

The Army responded to and denied KSD's agency protest on September 15, 2005. In its response, the Army stated that because Boeing developed the "Fat Boy" at private expense, "the technical data package is proprietary data not owned by the Government, and therefore unavailable for distribution by the Army." The Army further stated that: "The Main Rotor Strap Assembly is not a commercial item as defined by the Federal Acquisition Regulations. (FAR) Subpart 2.101." In another AMCOM internal memorandum, the Army indicated that "the strap pack does not qualify as a commercial item under the Federal Acquisition Regulation (FAR) 2.101(b), definition of a commercial item. The AH-64 Attack Helicopter is dedicated to a military function with no civilian counterpart." Similarly, in the July 25, 2005 J&A, for the "Fat Boy" strap pack, the Army further stated that "none of these items are identified as commercial items."

KSD initially protested to the General Accounting Office (GAO), which dismissed KSD's protest on October 31, 2005.

> The GAO found that KSD was "not an interested party within the meaning of [GAO's] Bid Protest Regulations, 4 C.F.R. § 21.0(a) (2005)." In its opinion, the GAO stated: "We have consistently held that, where an agency issues a presolicitation notice advising that it intends to conduct a sole-source acquisition, a prospective offeror is required, as a perquisite [sic] to filing a protest in our Office, to have submitted a timely expression of interest in response to the FedBizOp[p]s notice. . . . It follows that where, as here, a firm does not submit a timely expression of interest in response to the presolicitation notice, it is ineligible to compete for the requirement." Thus, the GAO dismissed KSD's protest because it found that it did not respond to AMCOM's presolicitation notice posted on the FedBizOpps website on May 17, 2005. KSD filed its bid protest complaint and motions for preliminary and permanent injunction in this court on November 22, 2005.
>
> KSD, Inc. argued that the government's actions violated Competition in Contracting Act (CICA) by failing to properly compete the contract for "Fat Boy" strap packs. [21]

Ultimately, the court found that the Army had acted reasonably in announcing a sole source award for the "Fat Boy" contract. Specifically, the court found that since the Army had not licensed data rights from MDHC, it did not "improperly withhold" them from KSD. Furthermore, the court found that the Army had provided a proper justification for a sole source procurement (based on its lack of technical data rights pertaining to the "Fat Boy" strap pack):

> In the 2001 contract, the government specifically negotiated away its rights to any technical rights for the "Fat Boy" strap pack. Therefore, when the government solicited the 2005 contract, it properly indicated that it did not have technical data rights and that Boeing was the only approved source of the "Fat Boy" strap pack. Moreover, KSD, Inc. was not an approved source to supply the product. Because the plaintiff has not proven that the government's actions were arbitrary, capricious, or otherwise not in accordance with the law, or that the plaintiff was prejudiced, the court denied the plaintiff's motion for preliminary and permanent injunctive relief. [21]

Appendix F: Software cost estimation methods

The function point method

The Function Point method was pioneered at IBM in the mid-1970s. Allan Albrecht, an IBM software engineer, first published a description of this approach in 1979 [29]; Albrecht and Gaffney published the first major refinement in 1983 [30]. Since 1986, the International Function Point User Group (IFPUG) has maintained a *Function Point Counting Practices Manual.* The current version can be downloaded from http://www.ifpug.org/.

Anthony DeMarco, president and managing member of Price Systems LLC., defines Albrecht's approach as follows:

> Function point sizing involves counting five different categories of functions in a software application: inputs, outputs, inquiries, interfaces, and internal files. These are functions the user of the application can see and identify. Each function is qualified in terms of complexity (Low, Average, or High) and then multiplied by a corresponding complexity weight to achieve a function point count, a measure of the size of the function. The sum of function point counts for the functions is called the total unadjusted function point count (UFPC). Next, fourteen general system characteristics are rated with respect to degree of influence, zero through five with zero indicating no influence and five indicating an extremely strong influence. The characteristics include qualities such as data communications, performance, and operational ease. The sum of the degrees of influence for the fourteen characteristics is used to make a value adjustment to the UFPC. The result is the total function point count for the application. [31]

Feature point method

The Feature Point method was developed in 1986 at Software Productivity Research (www.spr.com) under the auspices of Capers Jones. Chapter 13 of the Air Force *Guidelines* defines feature points as follows:

A derivative of function points, feature points were developed to estimate/measure real-time systems software with high algorithmic complexity and generally fewer inputs/outputs than MISs....In addition to the five standard function point parameters, feature points include an algorithm(s) parameter which is assigned the default weight of 3. The feature point method reduces the empirical weights for logical data files from a value of 10 to 7 to account for the reduced significance of logical files in real-time systems. ([25], p. 13-9)

Jones [32] provides further details on the differences between the function point and feature point methods.

Predictive object points (POPS)

The POPs metric was developed by Arlene Minkiewicz at PRICE Systems LLC and first published in 1997. Minkiewicz describes the approach as follows:

The POPs metric combines several measures popular in the literature to establish a metric suitable for predicting effort and tracking productivity. The metric at the heart of the POPs calculation is Weighted Methods per Class (WMC). This metric examines each top-level class (or each distinct object from the user's perspective) and assigns a weight to the behaviors (methods) of that class. Once a value for WMC has been calculated, the POPs counter combines this with information about the groupings of objects into classes and the relationships between these classes of objects to assign the POPs count. [33]

Glossary

AMCOM	Army Aviation and Missile Command
ARS	Adaptor rail system
AWACS	Airborne Warning and Control System
BUIS	Back up iron sight
C4I	Command, Control, Communications, Computers, & Intelligence
CDRL	Contract Data Requirements List
CICA	Competition in Contracting Act
COCOMO	COnstructive COst MOdel
COTS	Commercial-off-the-shelf
CS	Computer software
CSD	Computer software documentation
DAU	Defense Acquisition University
DFARS	Defense Federal Acquisition Regulation Supplement
DID	Data Item Description
DOD	Department of Defense
FedBizOpps	Federal Business Opportunities web site
FPA	Government-furnished equipment
GFE	Government-furnished equipment
ICP	Item, component, process
IDCC	Integrated Dual-use Commercial Companies
IDIQ	Indefinite delivery, indefinite quantity

IFPUG	International Function Point User Group
MDHC	McDonnell-Douglas Helicopter Company
MIS	Management information system
NDI	Non-developmental item
OSS	Open source software
PNVG	Panoramic night vision goggle
PRICE-H	PRICE hardware model
PRICE-L	PRICE lifecycle model
PRICE-S	PRICE software model
RFP	Request for proposal
RUL	Remaining useful life
SBIR	Small Business Innovative Research
SLIM	Software Lifecycle Management
SLOC	Software lines of code
TD	Technical data
UFPC	Unadjusted function point count
WBS	Work break-down structure
WMC	Weighted Methods per Class

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